$$\eta = \frac{S * P.F}{S * P.F + P_i + P_{cu}}$$

Sheet

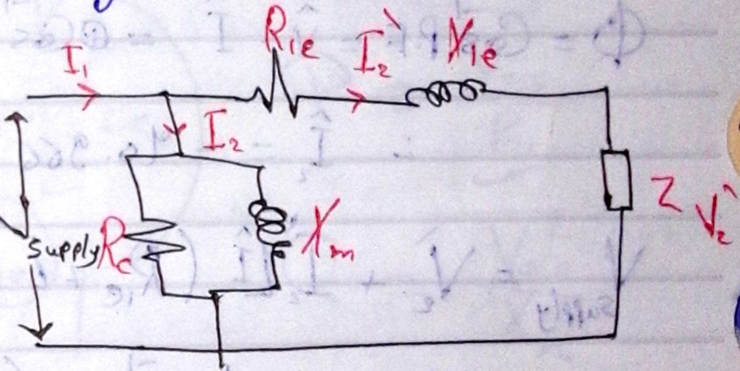
[1] 1ϕ - Transformer, 220 / 240 V ($V_1 = V_2'$, V_2)
50 Hz

$R_{1e} = 0.02\ \Omega$, $X_{1e} = 0.2\ \Omega$

O.C - Test $\Longrightarrow$ 220 V, 1.8 A, 39.6 W $\rightarrow P_i$

Load $\Longrightarrow$ 3 kW, 0.8 lag, 240 V ($\cos\phi$, $\oplus$, V_2) (عشان ده الحمل)

Req:- R% , η



$\phi = \cos^{-1} 0.8 = 40.966$

$P_{load} = V_2' I_2' P.F$

$3000 = 220 * \cancel{\ } I_2' * 0.8 \Rightarrow I_2' = 17.0455$ A

$$R\% = \frac{I_2' R_{1e} \cos\phi + I_2 X_{1e} \sin\phi}{V_1} =$$

$36.8 \leftarrow$ 0.8

$\boxed{2}$ 1100/110 V step down 1-ϕ transformer

$R_c = 2K\Omega$, $X_m = 1.5\ K\Omega$, $R_1 = 4\ \Omega$, $X_1 = 3\ \Omega$

$R_2 = 0.04\ \Omega$, $X_2 = 0.03\ \Omega$

Load $\Rightarrow$ 5.5 KVA , 0.8 lag , 110 V

Req :- V_{supply} , R% , η %

$R_2' = R_2 \left(\frac{1100}{110}\right)^2 = 4$

$X_2' = X_2 \left(\frac{1100}{110}\right)^2 = 3$

$\bar{I}_2' = \frac{S}{V_2'} = \frac{5500}{1100} = 5A$

$\phi = \cos^{-1} P.F = \hat{V} - \hat{I} = \cos^{-1} 0.8 = \hat{0} - \hat{I}$

$\therefore \hat{I}_2 = -40.966 = -\cos^{-1} 0.8$

$V_{supply} = V_2' + I_2' \angle \hat{I}\ (R_{1e} + i\ X_{1e})$

$= 1100 + 5 \angle -\cos^{-1} 0.8\ \left(\underbrace{(4+4)}_{8} + i(3+3)\right)$

$(4 - i3)\ 2\ (4 + i3)$

$1100 + 2(16 + 9) = 1150$

$P_i = \frac{V_{supply}^2}{R_c}$ | approximate $P_i = \frac{1150^2}{2000} = 661.25$ watt

$\eta = \frac{I_2' V_2' \cos\phi}{I_2' V_2' \cos\phi + P_i + I_2'^2 (R_{1e})} = \frac{5 \times 1100 \times 0.8}{5 \times 1100 \times 0.8 + 661.25 + 5^2 \times 8}$

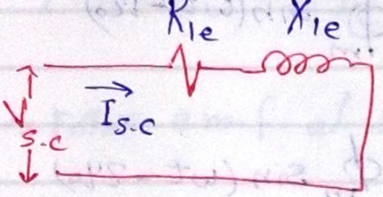
$= 83.63\ \%$

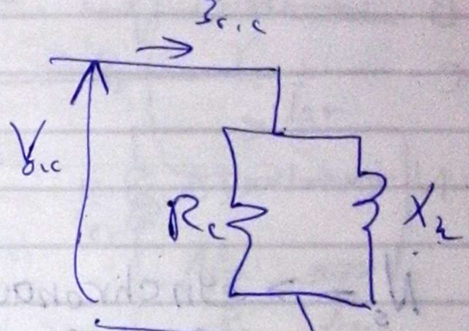
$\boxed{5}$ 5 KVA, 500/250 V, 50 Hz, 1ϕ - Transformer

O.C. Test $\Rightarrow$ 500 V, 1 A, 50 W (P_i) (L.V side open)

S.C. Test $\Rightarrow$ 25 V, 10 A, 60 W (L.V side shorted)

Req: η % (F.L, 0.8 lag) ; R % (F.L, 0.8 lead) ; η (60% FL, 0.8 lead)





$P = I_{s.c}^2 \, R_{1e}$, $S = V_{s.c} \times I_{s.c}$

$Q = \sqrt{S^2 - P^2} = I_{s.c}^2 \, X_{1e}$

$P = \frac{V_{o.c}^2}{R_c}$

$Q = \frac{V_{o.c}^2}{X_m}$

$S = V_{o.c} \, I_{o.c}$

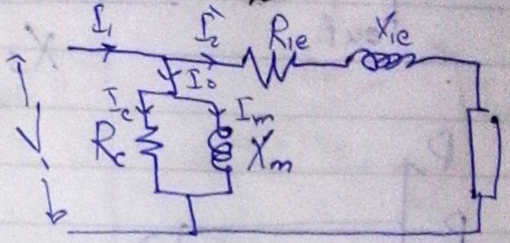
^_^ transformer حل مسألة ٤ شيت

Data:- A 10 KVA, 220/110 V transformer

$R_1 = 0.02\ \Omega$ $X_1 = 0.04\ \Omega$

$R_2 = 0.01\ \Omega$ $X_2 = 0.01\ \Omega$

$R_c = 200\ \Omega$ $X_m = 300\ \Omega$



if the transformer is supplying 75% of its full load at unity power factor & rated secondary voltage find

(a) The transformer referred circuit parameters
(b) The voltage regulation
(c) The transformer efficiency

$$R_{1e} = R_1 + R_2' = R_1 + R_2/k^2 \quad ; \quad k = \frac{V_2}{V_1} = \frac{110}{220} = 0.5$$

$$= 0.02 + \frac{0.01}{0.5^2} = 0.06\ \Omega$$

$$X_{1e} = X_1 + X_2' = 0.04 + \frac{0.01}{0.5^2} = 0.08\ \Omega$$

$$R_{2e} = R_2 + k^2 R_1 = 0.01 + 0.5^2 * 0.02 = 0.015\ \Omega$$

$$X_{2e} = X_2 + k^2 X_1 = 0.01 + 0.04 * 0.5^2 = 0.02\ \Omega$$

at F.L :- $I_1 = \frac{10*10^3}{220} = 45.45\ A$

$\cancel{I_2 = \frac{10*10^3}{110} = 90.91\ A}$

$$I_c = \frac{V_1}{R_c} = \frac{220}{200} = 1.1\ A \quad , \quad I_m = \frac{220}{300} = 0.667\ jA$$

$\cancel{I_2' = I_1 - I_o = 45.45}$

$$P_i = I_c^2 R_c = 1.1^2 * 200 = 242 \text{ watt}$$

$$P_{cu} = I_2'^2 R_{1e} = 45.45^2 * 0.06 = 124 \text{ watt}$$

$$\eta = \frac{n V_2' I_2' \cos\phi}{n V_2' I_2' \cos\phi + P_i + n^2 P_{cu}} = \frac{220 * 45.45 * 1 * 0.75}{0.75 * 220 * 45.45 + 242 + 0.75^2 * 124} \times 100$$

$$\eta = 96 \%$$

$$R = \frac{I_1 R_{1e} \cos\phi \mp I_1 X_{1e} \sin\phi}{V_1}$$

$$= \frac{45.45 * 0.06}{220} * 100 = 1.24 \%$$